Claims

1.An acoustic echographic method for underwater exploration, making use of the bubble-implosion effect, characterised in that it comprises the following steps:
the realisation of a parabolic transmitter (1), which is immersed in water and is open at its base, said transmitter having a thickness sufficient to prevent energy dispersions through its walls and presenting a predetermined focal length, the latter being selected to be sufficiently long so that the expansion of the bubble generated by the electric discharge occurring between two electrodes (15) that are symmetrically arranged with respect to the focus (F), is not hindered by the walls of the paraboloid formed by the transmitter (1); and wherein said electrodes (15) are adjustable in the direction of the line that joins them, to allow to increase or decrease their reciprocal distance (d);
the realisation of a parabolic receiver (3), said receiver being open at its base, being immersed in water, and having a pressure sensor (17) arranged substantially at the focus of the receiver (3);
the connection of said transmitter (1) to an electronic unit (2), having a function of control and energy supply, said electronic unit supplying electrostatic energy to said electrodes (15) and transmitting an electric trigger signal to means (4) of the receiver;
the connection of said receiver (3) to data processing and display means (4,5,6,7,8), for obtaining diagrams of the type of an oscillogram relating to received signals, and/or for obtaining acoustic images of these received signals;
and a last step, in which, given a certain value of the electrostatic energy (E) to be supplied to the electrodes (15), and given a certain degree of water salinity, the distance (d) between said two electrodes (15) is adjusted so that a maximum delay time (t) is obtained between the occurrence of the breakdown electric discharge and a signal due to bubble implosion of the bubble formed during the same discharge; said

maximum delay time of the bubble implosion signal being univocally correlated to the maximum acoustic efficiency value, given by the ratio between the electrostatic energy (E) and the acoustic energy of the bubble implosion signal (23), and wherein, under these circumstances, the amplitude of the primary signal (13") directly generated by the breakdown discharge is minimal or negligible.

2. A method according to claim 1, wherein the distance between the receiver (3) and transmitter (1), and/or the energy (E), are all adjusted during prospecting operations according to the depth of the region below the seabed to be subjected to the survey.

3. A method according to claim 1, wherein said electrodes are made of tungsten.

4. A method according to claim 1, wherein the employed pressure sensor (17) is made of a piezoelectric ceramics having a flat frequency response, for instance up to values of about 400 kHz.

5. A method according to claim 1, wherein the orientation of the receiver (3) may be varied for obtaining a better reception of the echo generated by the reflection of the bubble-implosion signal on the seabed, on the sediments, on an archaeological find, and/or on an object which is immersed in water at a certain distance from the seabed.

6. A method according to claim 1, including various scanning operations, performed along parallel straight lines in order to obtain an acoustic image, and/or including several measurements, effected along a horizontal line which comprises a position located on the vertical line passing through a hypothetical object or a possible archaeological find to be detected, analysed, or displayed.

7. A method according to claim 6, wherein the acoustic images, obtained in map

form, namely as planar or tridimensional distribution of an acoustic parameter such as the acoustic intensity, are derived by means of a signal processing software, suited to provide high-resolution acoustic images, and which has been developed on scale models in a lab basin, and wherein the selected model scale and frequency region are such to permit extrapolation of the results to include real conditions, based on physical similarity considerations.

8. An apparatus for carrying out the acoustic echographic method based on the bubble-implosion effect according to anyone of the preceding claims, comprising:
a parabolic transmitter (1) associated with a control unit (2), the latter being used to supply electrostatic energy (E) to two electrodes (15) arranged substantially symmetrically to the focus (F) so as to face each other at a mutual distance, this distance being adjustable through regulation means (19);
a parabolic receiver (3), connected to data processing and display means (4,5,6,7,8) triggered by an apposite trigger signal, said receiver including a pressure sensor (17) which is substantially located at the focus of the receiver (3);
wherein, the mutual distance (d) between the electrodes (15) is adjusted according to the method claims 1-7, the thickness of the walls of the transmitter (1) renders substantially negligible the bubble implosion signal passing through said walls which is directly transmitted towards the receiver (3), and the focal length of the transmitter (1) is selected so that it does not hinder the formation of the bubble until it reaches its maximum size (R).

9. An apparatus according to claim 8, wherein said electrodes (15) are made of tungsten.

10. An apparatus according to claim 8, wherein said regulation means (19) are micrometer screws.

11. An apparatus according to claim 8, wherein said sensor (17) is a piezoelectric ceramics with a flat response up to about 400 kHz.

12. An apparatus according to claim 8, wherein the data processing and display means, which are triggered by an apposite trigger signal sent by the electronic unit (2), include a ADC filter (4), a DSP microprocessor card (5), a dedicated personal computer (6), a display monitor (7) for visualising acoustic images, a memory (8), and possibly also visualisation means for the display, in the form of an oscillogram, of the analogue signal that constitutes the echo.

13. An apparatus according to claim 8, wherein the parabolic transmitter (1) forms a block of suitable material, for instance aluminium, and is obtained by means of turning from such block, which may have any suitable form, e.g. cylindrical.

14. An apparatus according to claim 8, wherein the receiver (3) has a mechanical articulated joint system allowing its orientation.

15. An apparatus according to claim 8, having a horizontal guide rail for the adjustment of the mutual distance of the electroacoustic transducers (1; 3).